High Speed, High Resolution X-ray System for Inspecting Integrated Circuits

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Description:
OBJECTIVE: Develop an affordable x-ray microscope system for use in performing integrated circuit (IC) reverse engineering. DESCRIPTION: X-ray microscopy using a synchrotron as the x-ray source has been demonstrated to be an extremely valuable tool in the performance of high throughput integrated circuit evaluation and reverse engineering efforts. However, synchrotron x-ray sources are prohibitively expensive (approximately $1B) for commercial and government applications. While affordable non-synchrotron sources have also been successfully demonstrated, the evaluation time using these systems is unacceptably slow (approximately1- year). Prior metrics indicate the ability to image several thousand gates using non-synchrotron sources, but that this would take close to a year to accomplish. An x-ray microscopy system that is affordable (less than $2M) and has acceptable throughput (less than 40 hours per image) is required for timely integrated circuit evaluation and reverse engineering efforts. PHASE I: Perform a study to evaluate the feasibility of constructing an x-ray microscope system that is capable of generating x-ray images in sufficient detail to allow the identification of all of the individual interconnects and gates within a 1mm X 1mm, 100 nm nine-layer metal integrated circuit using a stand-alone non-synchrotron x-ray source. Demonstrate, through analysis, that the time required to collect such images will be less than 40 hours and that the resolution of the microscope will be better than 100nm. PHASE II: Develop and demonstrate a prototype x-ray microscope system that is capable of generating x-ray images in sufficient detail to allow the identification of individual interconnects and gates within a 1m two-layer metal integrated circuit using a stand-alone non-synchrotron x-ray source. The time required to

image all layers of an IC must not exceed 40 hours. PHASE III: Optimize the design of the prototype microscope system in Phase II and demonstrate the system"s ability to meet throughput (40 hours) and resolution (100 nm) metrics in Phase I. POTENTIAL DUAL USE APPLICATIONS: This technology, when proven, will allow for the development of low cost x-ray systems usable for the detailed inspection of gates and interconnects within integrated circuits. At the present time, these inspections can only be performed with the use of an extremely expensive synchrotron x-ray source.